PUNA GEOTHERMAL VENTURE

REVIEW AND RESPONSE TO THE ELEMENT II REPORT

REVIEW OF EMERGENCY PLAN AND RESPONSE TO THE 12 JUNE 1991 UNCONTROLLED VENTING OF THE PUNA GEOTHERMAL VENTURE (PGV) KS8 GEOTHERMAL WELL

PUNA GEOTHERMAL VENTURE
REVIEW AND RESPONSE TO THE
ELEMENT II REPORT

REVIEW OF EMERGENCY PLAN AND RESPONSE TO THE
12 JUNE 1991 UNCONTROLLED VENTING OF THE
PUNA GEOTHERMAL VENTURE (PGV) KS8 GEOTHERMAL WELL

PGV Response to the Element II Executive Summary.

Based upon Puna Geothermal Venture's (PGV)'s own internal review of the information available regarding the emergency response to the KS-8 uncontrolled flow event and its consequences, and the actions taken by all parties during the emergency, PGV believes that its approved Emergency Response Plan (ERP), specifically Section 8.2.1. of the PGV ERP, adequately anticipated the possible occurrence of such an uncontrolled flow event. The PGV ERP provided PGV, emergency response personnel and the public with generally accurate information regarding the possible consequences of such an event. PGV concurs with the principal finding of the Element II Report that "The actual implementation of the PGV Emergency Response Plan (ERP) went reasonably well."

PGV also agrees with the Element II Report that there appears to have been some confusion on the part of emergency response personnel and the public during and after the uncontrolled flow event regarding how to proceed, the applicability of the temporary housing cost reimbursement, and the PGV employee alarm system. This apparent public and agency confusion regarding the emergency episode underscores the need for the Hawaii County Civil Defense Agency (HCD), other government agencies, and PGV to work harder to educate the community regarding the PGV ERP. PGV believes that everyone involved must recognize that the PGV ERP is not designed to direct the response actions of either the agencies or the communities in the event of any emergency at the PGV facility. This is the responsibility of the HCD and the HCD's emergency implementation plan. Accordingly, PGV believes it also necessary that the public and other government agencies be educated concerning the HCD's implementation plan for any emergency which may arise on the PGV facility site (see PGV Responses N and O).

PGV generally concurs with the recommendations of the Element II Report, and has cooperated and will continue to fully cooperate with representatives of the Hawaii State Department of Health, Hawaii State Emergency Response Commission, and the Hawaii County Local Emergency Response Commission in these matters (see PGV Responses V through AA). PGV concurs with the recommendation that the Hawaii State Department of Health (DOH) conduct a review of the "action levels" for hydrogen sulfide, although PGV believes that the "action levels" already proposed by DOH are appropriate and should be accepted as the "action levels" for hydrogen

sulfide (see PGV Responses J and N). PGV also generally agrees with the intent of the recommendation to review the PGV ERP, since the PGV ERP provides that it "will be updated as appropriate when necessary" (see PGV Responses M and O).

A. Page 2, paragraph 1, time of the uncontrolled flow event.

Please see PGV Response C.

B. Page 2, paragraph 3, employee alarm system.

PGV concurs that the employee alarm system located at the PGV project facility was not intended to alert nearby residents of any emergency situation requiring their evacuation. This is made very clear in Section 5.1 (discussing the alarm horn's use for on-site warning of PGV personnel) and Section 5.2 (which states that warning to residents will be provided by the Hawaii County Civil Defense Agency (HCD)) of PGV's Emergency Response Plan (ERP). However, the public confusion underscores the need for the HCD, other government agencies, and PGV to work harder to educate the community regarding the PGV ERP, and especially the HCD's implementation plan for any emergency which may arise on the PGV facility site. See also PGV Responses N and O.

C. Page 3, Wednesday, 12 June 1991, first point regarding time of the uncontrolled flow event.

The uncontrolled flow event did not occur at 23:06 on June 12, 1991. According to the records of the on-site mudlogger, the uncontrolled flow event occurred at 23:16 (as shown on the mudlogger's clock) on Wednesday, June 12, 1991 (see also page 8 of the Element I Report). Based upon a subsequent review of the mudlogger's clock and a comparison to the correct time, the actual time for the initiation of the uncontrolled flow event would be 23:19. These times have also been confirmed with other individuals who were on-site at the time of the uncontrolled flow event. Based on the log of the event prepared by HCD, PGV first reported the uncontrolled flow event to the Hawaii Police Department (HPD) at 23:20, although the actual time of the first report may have been as late as 23:25. This means that from one (1) to nine (9) minutes elapsed between the initiation of the uncontrolled flow event and the initial notification of the event by PGV to the HPD.

D. Page 3, Wednesday, 13 June 1991, first point regarding PGV recommendation for evacuation.

HCD logs indicate that PGV's recommendation to commence evacuation of Lanipuna Gardens was made to Hawaii HPD at 00:35 on Thursday, 13 June, 1991, not 00:10.

E. Page 3, Wednesday, 13 June 1991, fourth point regarding initial PGV monitoring data.

PGV concurs that the initial monitoring of off-site ambient hydrogen sulfide concentrations by PGV at 01:00 indicated concentrations of 22 and 29 parts per million (ppm). (But see discussion below.) Once these levels were measured, PGV immediately reported the values to HCD without attempting to gather any more data, since these two readings were relatively high and reinforced the earlier decision to evacuate the residents of Lanipuna Gardens.

However, because the subsequent off-site measurements of ambient hydrogen sulfide concentrations taken either through spot checks or measured by the fixed monitoring stations during the event were all 40 times less than these original measurements, PGV recently investigated in detail the validity of these readings. Based upon conversations with the PGV staff involved in taking the readings and communications with the manufacturer of the monitoring instrument, PGV now believes that these two initial off-site ambient hydrogen sulfide concentration readings were in error (see Attachment 1).

During the uncontrolled flow event, all parties acted responsibly in assuming that these initial hydrogen sulfide readings were accurate; to do otherwise during an emergency situation would not be prudent. However, PGV now believes sufficient information is available to document that the highest measured instantaneous ambient hydrogen sulfide concentration recorded during the uncontrolled flow event was approximately 0.5 parts per million (ppm) [500 parts per billion (ppb)], not the 20 to 29 ppm (20,000 to 29,000 ppb) previously reported. The validity of these initial high values has not been supported by any of the modeling subsequently conducted as a part of the review of the uncontrolled flow event by the state's review panel (see PGV Response G to the Element III-II Report).

F. Page 3, Wednesday, 13 June 1991, fifth point regarding DOH-recommended hydrogen sulfide action level.

The 10 ppm (10,000 ppb) one hour average ambient hydrogen sulfide level recommended by the Hawaii Department of Health (DOH) as the level at which

residents should be relocated is the same value recommended by DOH in its letter of June 7, 1990 commenting on its review of Version 2 (dated April 12, 1990) of the PGV ERP before it was approved by HCD. The 100 ppb (0.1 ppm) one hour average "alert", 1.00 ppm (1,000 ppb) one hour average "warning", and the 10.0 ppm (10,000 ppb) one hour average "emergency" "action levels" recommended by DOH at that time (see Attachment 2 and PGV Response N) were subsequently incorporated into Version 3 of PGV's ERP, which was submitted to the HCD on July 2, 1990 (see Attachment 3). The DOH, in their letter of June 17 [sic], 1990 (see Attachment 4) accepted PGV's Version 3 of the ERP, stating that the ERP would provide "an excellent reference for state and county agencies to use for emergency planning purposes as they relate to the PGV facility." However, HCD rejected Version 3 of the ERP, and required that PGV remove from the ERP any reference to specific "action levels" for hydrogen sulfide. Accordingly, the current approved version of the ERP, Version 5, does not present any recommendations regarding ambient hydrogen sulfide "action levels".

G. Page 4, first paragraph under Release Notification regarding time of the uncontrolled flow event.

As discussed above in PGV Response C, because the correct time for the commencement of the uncontrolled flow event was either 23:16 (as shown on the mudlogger's clock) or 23:19, and PGV notified the HPD at either 23:20 or 23:25, the actual time between the initiation of the uncontrolled flow event and notification to the authorities was between one (1) and nine (9) minutes, not the nineteen (19) minutes presented in the Element II Report.

H. Page 5, paragraph 1, notification of release of reportable quantity.

PGV reported the event to the National Response Center on July 30, 1991. Written follow up notification to the State Emergency Response Commission of the hydrogen sulfide release was submitted on August 1, 1991.

I. Page 5, paragraph 1 under Site Response by PGV.

The Element II Report correctly notes that in order to control the well, it was necessary to divert as much of the geothermal steam as possible away from the rig floor in order to initiate control activities. As a result, PGV opened the four-inch choke line and allowed steam to flow through the line, to be discharged horizontally over the on-site mud pit. Discharge of geothermal steam or fluid through the horizontal choke line was never considered as a "normal" or "upset" operation under any of the permits, nor was it specifically considered as an emergency event under the

PGV ERP, principally because such a discharge was never considered as a likely emergency occurrence. Based upon PGV's review of the mechanical aspects of the uncontrolled flow event, PGV has now redesigned the blowout prevention equipment stack and wellhead to provide multiple pathways for controlling any unexpected flows of drilling muds or geothermal fluids, and has provided mechanisms to abate the hydrogen sulfide that may be contained in the flow through each pathway. For further information regarding the changes to wellhead equipment and flow control/hydrogen sulfide treatment, see Attachment 1 to PGV's Response to the Element I Report.

J. Page 5, paragraph 3 under Site Response by PGV

PGV is unaware of any significant potential for contamination of personal protection equipment as a result of exposure to the hydrogen sulfide concentrations contained in the geothermal fluid or steam. Only at extremely high concentrations of hydrogen sulfide can "contamination" occur, and then the only "decontamination" required is to air out the "contaminated" materials. PGV has previously offered to assist emergency response personnel in receiving training regarding hydrogen sulfide, an offer which some members of the Hawaii County Fire Department (HFD) have already accepted. In addition, PGV previously assured the HFD that PGV would always have at least two (2) self-contained breathing units available to the HFD if they needed them. PGV believes that such training and equipment may still be beneficial to the emergency response personnel, and again offers to provide appropriate assistance.

K. Page 6, paragraph 2 under Public Alert Notification and Evacuation regarding the high hydrogen sulfide concentrations.

While PGV believes that the ambient hydrogen sulfide concentrations "may have declined rapidly after the initial release," the initially reported high hydrogen sulfide concentrations (22 and 29 ppm) have now been determined to be incorrect (see discussion above in PGV Response E). PGV believes that the 0.5 ppm (500 ppb) concentration of hydrogen sulfide measured by DOH at 01:25 on June 13, 1991, on Lanipuna Street was actually a more accurate number.

L. Page 6, paragraph 3 under Public Alert Notification and Evacuation regarding notifications given to residents.

PGV has received comments from a number of residents of the community, principally through the relocation compensation forms submitted to PGV, which indicate that some of the residents also were confused regarding the directions they were receiving from the emergency response personnel. Many residents, in fact,

believed that the emergency response personnel providing the notification were suggesting evacuation. As such, it may be that some of the notifications given to the residents were not completely clear.

M. Page 7, paragraph 4 under Emergency Air Quality Monitoring regarding taking ambient air hydrogen sulfide samples from the community.

Between the time of the initiation of the uncontrolled flow event and the time that the initial community monitoring results were collected, all available PGV staff who were trained in the use of the Jerome monitoring equipment were involved on-site in the evacuation of personnel and the stabilization of the well. As a result of the knowledge gained from the uncontrolled flow event, PGV has initiated a program of training more project personnel in the basic use of the Jerome monitoring unit, and has purchased a second Jerome monitoring unit for use by the project and agency staff.

At the time PGV purchased its first Jerome monitoring unit, both the HCD and DOH were offered the opportunity to purchase one or more identical units, with the objective of reducing the cost per unit. However, neither agency was able to locate the funds sufficient to participate in such a group purchase. PGV believes it may be appropriate, whether or not any other agencies purchase a similar monitoring unit, for appropriate agency staff who may be responding to a possible future uncontrolled flow event be trained in the use of the Jerome monitoring units. On-site monitoring of hydrogen sulfide emissions, combined with the on-site hydrogen sulfide alarms designed to protect workers' safety, should eliminate the need for community-wide monitoring by an alarm-type monitor. In addition, implementation of the recommendations contained in the Element III Reports regarding a reconfiguration and integration of the ambient air hydrogen sulfide monitoring network will provide for the opportunity to determine community hydrogen sulfide concentrations during a possible future uncontrolled flow event, should one occur.

N. Page 8, paragraph 2 under Adequacy of Action Levels.

See PGV Response F. The "action levels" recommended by the DOH in its letter of June 27, 1990 (see Attachment 2) contains "alert", "warning", and "emergency" levels. It is clear from the levels of ambient hydrogen sulfide measured off-site during the uncontrolled flow event that the DOH-recommended "alert" level of 100 ppb (0.1 ppm) over a one-hour averaging period was exceeded, and there is some possibility that the recommended "warning" level of 1.00 ppm (1,000 ppb) over a one-hour averaging period may have been exceeded. However, based on all currently

available data, it is clear that the DOH-recommended "emergency" level of 10.0 ppm (10,000 ppb) over a one-hour averaging period was not exceeded.

PGV recommends that the "action levels" originally recommended by DOH and incorporated by PGV into Version 3 (see Attachment 3) of the PGV ERP (but subsequently removed at the request of HCD) be accepted as the appropriate "action levels" for hydrogen sulfide, and information regarding these levels, the possible effects which individuals may experience as a result of these levels, and the appropriate actions to be taken by the public, emergency response personnel, and PGV, be disseminated widely to both the public and emergency response personnel. PGV believes that if this information had been accepted and more widely distributed at the time of the event, confusion over the emergency situation would not have been as great.

O. Page 8, paragraph under Community Relations and Emergency Preparedness.

PGV agrees that there appears to have been some confusion on the part of both emergency response personnel and the public during the uncontrolled flow event. PGV also concurs with the Element II Report that minimizing such confusion, through increased communication among PGV, the community and regulatory agencies, is always beneficial. See also PGV Response N.

However, PGV believes that it has never been the objective of the PGV ERP to direct the response actions of either the agencies or the communities in the event of any emergency at the PGV facility. The PGV ERP is specifically designed to provide "the basis of all actions by PGV's personnel and management staff in responding to [emergency] situations," and the HCD, and other government agencies, have always made it clear that the PGV ERP would be used by these agencies to prepare agency emergency response implementation plans which would be relied upon by the agencies in the case of an emergency. PGV concurs with the primary observation of the Element II Report that "the actual implementation of the PGV emergency response plan went reasonably well." PGV has, and will continue to be, willing to work with the HCD and other government agencies to ensure that all parties involved understand what may be expected of them in an emergency.

P. Page 9, paragraphs 1, 2, and 3 regarding modeled and measured hydrogen sulfide concentrations.

PGV agrees that spot measurements of ambient hydrogen sulfide concentrations taken throughout the community were within the ranges of modeled or predicted hydrogen sulfide values estimated in the PGV ERP. However, it must be recognized that the

modeled values are for one-hour averages, whereas the spot measurements are instantaneous readings, which may be two, three or more times the hourly averages. In addition, EPA-approved air dispersion models are typically very conservative, and thus substantially over-estimate actual pollutant concentrations under modeled circumstances, especially short-term (such as one-hour) concentrations.

PGV agrees that spot monitoring measurements may not be taken at the actual point of highest concentration, thus necessitating building-in a safety factor; however, such a safety factor is already built-in since spot measurements overestimate the one-hour averages, which are the numbers used to determine the hydrogen sulfide "action levels". PGV believes also that additional analysis of the available air monitoring data may help to better verify the actual atmospheric concentrations experienced during the uncontrolled flow event. See PGV Responses F and G to the Element III-II Report and PGV Response E.

Q. Page 9, paragraph 4, regarding additional hazard analyses.

See PGV Response I.

R. Page 9, paragraph 5, regarding ambient hydrogen sulfide monitoring capabilities.

See PGV Response M.

S. Page 9, paragraph 6, regarding controlling upset conditions.

See PGV Response I.

T. Page 9, paragraph 6, regarding reporting requirements.

See PGV Response N.

U. Page 10, paragraph 3, regarding DOH hydrogen sulfide "action" levels.

See PGV Response N.

V. Page 11, Recommendation A, revised hazard analyses.

PGV generally concurs with this recommendation, and has cooperated and will continue to fully cooperate with representatives of the Hawaii State Department of Health, Hawaii State Emergency Response Commission, and the Hawaii County Local Emergency Response Commission in this matter.

W. Page 11, Recommendation B, review of "action" levels.

PGV also concurs with this recommendation, although we believe that the "action levels" already proposed by DOH are appropriate. See also PGV Responses J and N.

X. Page 11, Recommendation C, review of hydrogen sulfide monitoring capability.

PGV concurs with the recommendation. See specifically PGV Responses M and O.

Y. Page 11, Recommendation D, review and revision of PGV ERP.

PGV generally concurs with the intent of this recommendation since the PGV ERP provides that it "will be updated as appropriate when necessary." PGV ERP, p. 1 of Chapter 1. In addition, see specifically PGV Responses M and O.

Z. Page 12, Recommendation E, community confusion regarding housing reimbursement and PGV employee alarm system.

PGV understands the rationale of this recommendation and agrees that any confusion referred to in Recommendation E should be minimized. PGV is reviewing its policies with respect to these matters and will work with the Hawaii County Planning Department to avoid similar confusion in the future.

AA. Page 12, Recommendation F, PGV notification of hydrogen sulfide releases.

PGV concurs, and has already completed the additional notifications. See PGV Response H.